

REMARKS

Claims 1-19 and 28-31 remain pending in the present application. In the Office Action, claims 1-19 and 28-31 are rejected under 35 U.S.C. § 103(a) as being obvious over admitted prior art as evidenced by Choi, et al (U.S. Patent No. 4,663,191), Holloway, et al (U.S. Patent No. 4,657,628), Maris, et al (U.S. Patent No. 5,844,684), and Mifune, et al (U.S. Patent No. 5,298,278). The Examiner's rejection is respectfully traversed.

With regard to independent claim 1, Applicant describes and claims forming a layer comprised of a refractory metal, determining a thickness of the layer of refractory metal, and converting a portion of the layer of refractory metal to a metal silicide. For example, a metrology tool may be used to measure the as-formed thickness of the refractory metal layer. See Patent Application, page 10, ll. 12-13. Applicant further describes and claims determining a duration of an etching process to remove unreacted portions of the refractory metal layer based upon the determined thickness of the refractory metal layer and performing the etching process for the determined duration to remove the unreacted portions of the refractory metal layer. With regard to independent claim 12, Applicant additionally describes and claims depositing the layer comprised of the refractory metal above a plurality of source/drain regions and a gate electrode of a transistor, as well as converting the portion of the layer of refractory metal to the metal silicide by performing at least one anneal process.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally

available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. That is, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561 (Fed. Cir. 1986). In fact, the absence of a suggestion to combine is dispositive in an obviousness determination. *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573 (Fed. Cir. 1997). The mere fact that the prior art can be combined or modified does not make the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990); M.P.E.P. § 2143.01. Third, there must be a reasonable expectation of success. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. § 2142. A recent Federal Circuit case emphasizes that, in an obviousness situation, the prior art must disclose each and every element of the claimed invention, and that any motivation to combine or modify the prior art must be based upon a suggestion in the prior art. *In re Lee*, 61 U.S.P.Q.2d 143 (Fed. Cir. 2002). Conclusory statements regarding common knowledge and common sense are insufficient to support a finding of obviousness. *Id.* at 1434-35.

Moreover, it is claimed invention, as a whole, that must be considered for purposes of determining obviousness. A mere selection of various bits and pieces of the claimed invention from various sources of prior art does not render a claimed invention obvious, unless there is a suggestion or motivation in the prior art for the claimed invention, when considered as a whole. In this case, it is respectfully submitted that the obviousness rejection is improper for many reasons. First, even if the admitted prior art and the Choi, Holloway, Maris, and Mifune

references are combined, they do not disclose each and every feature of the claimed inventions. Second, there is no record support in the prior art for the conclusory statements made by the Examiner regarding what would be known or obvious to one skilled in the art. Lastly, even considering all the art and statements, there is no suggestion in the prior art of record for the entirety of the claimed invention.

The admitted prior art describes forming metal silicide regions on a gate electrode and source/drain regions by depositing a layer of refractory material above the gate electrode and the source/drain regions. Unreacted portions of the refractory material are removed, typically using a dilute acid bath. See Patent Application, pg. 3, ll.8-25. In contrast to the present invention, the duration of the described chemical removal process is based upon the greatest thickness that may be anticipated by the process. See Patent Application, pg. 4, ll. 7-10. Accordingly, the Applicant's admitted prior art is completely silent with regard to determining a thickness of the layer of refractory metal, determining a duration of an etching process to remove unreacted portions of the refractory metal layer based upon the determined thickness of the refractory metal layer and performing the etching process for the determined duration to remove the unreacted portions of the refractory metal layer.

At item 4 on page 5 of the Office Action, the Examiner argues that, in the admitted prior art, the thickness of the refractory metal layer is determined either by design rule or by previous routine experimentation. Applicants respectfully disagree. The anticipated thickness of the refractory metal layer described in the admitted prior art may be different than the thickness of the refractory metal layer formed by the methods set forth in independent claims 1 and 12, i.e. the determined thickness of the refractory metal layer. In particular, the thickness of the formed refractory metal layer may be less than the maximum thickness anticipated by the design process.

See Patent Application, page 4, ll. 11-12. The cited prior art also teaches that the anticipated thickness may be different from the determined thickness. For example, Holloway teaches that the anticipated thickness of the refractory metal layer may be different than the thickness of the formed refractory metal layer. In particular, Holloway states that a thickness of a TiSi_2 layer formed by a silicidation reaction will be "roughly" one to two times a thickness (d_1) of a titanium layer, "depending on reaction conditions." See Holloway, col. 7, ll. 50-57 and Figure 9A.

Moreover, the admitted prior art contains no suggestion or motivation to modify the admitted prior art to arrive at Applicant's claimed invention. The methodologies set forth in the pending claims are fundamentally different from the prior art methodologies described in the background section of the application. For example, in situations where the layer of refractory metal is less than the maximum thickness anticipated by the design process, the methodologies set forth in the background section of the application, *i.e.* the admitted prior art, results in subjecting the device to the etching process for a duration longer than would otherwise be required to remove the unreacted portions of the layer of refractory metal. In turn, this over-etching needlessly consumes some of the thickness of the metal silicide regions, which undesirably increases the sheet resistance of the metal silicide regions.

Furthermore, at no point does the admitted prior art disclose or suggest determining a duration of an etching process to be performed to remove the unreacted portions of the refractory metal layer **based upon the determined thickness** of the refractory metal layer. In fact, it is believed that the duration of the etching processes for removing the unreacted refractory metal layer described in the admitted prior art were determined based upon either an assumption as to the thickness of the resulting metal silicide layer and/or the amount of unreacted material to be

removed, or established for a worst-case scenario, wherein the duration was established for the largest amount of material to be removed that could reasonably be anticipated.


The Examiner relies on the combination of Choi, Holloway, Maris, and Mifune to teach determining a thickness of a layer of refractory metal. However, Applicants respectfully submit that the combination of Choi, Holloway, Maris, and Mifune fails to teach all the limitations of Applicant's claimed invention. In particular, the aforementioned references fail to teach or suggest determining a duration of an etching process to remove unreacted portions of the refractory metal layer based upon the determined thickness of the refractory metal layer and performing the etching process for the determined duration to remove the unreacted portions of the refractory metal layer. Furthermore, the admitted prior art teaches away from the Examiner's proposed modifications. In particular, the admitted prior art teaches a removal process that is designed for a "worst-case" situation, in which the parameters of the removal process are set based upon a greatest thickness anticipated for the refractory metal layer in an effort to ensure that the essentially all of the un-reacted refractory metal is removed from places where it should not be. See Patent Application, page 4, ll. 5-11.

For at least the aforementioned reasons, Applicant respectfully submits that claims 1-19 and 28-31 are not obvious over Applicant's admitted prior art or any other prior art of record and request that the Examiner's rejections be withdrawn.

It is respectfully submitted that all claims are in condition for allowance. The Examiner is invited to call the undersigned at (713) 934-4052 to discuss any additional steps that the Examiner may consider necessary for placing the application in condition for allowance.

Respectfully submitted,

Date: 5/22/03


Mark W. Sincell, Reg. No. 52,226
WILLIAMS, MORGAN & AMERSON, P.C.
10333 Richmond Avenue, Suite 1100
Houston, Texas 77042
(713) 934-7000
(713) 934-7011 (facsimile)

AGENT FOR APPLICANT